

United States Coast Guard Research and Development Center

2014

Annual Report



Commanding Officer's Message

USCG RESEARCH & DEVELOPMENT CENTER

Captain Dennis Evans

December 2014



The Research and Development Center (RDC) is the sole facility authorized to conduct research, development, test, and evaluation (RDT&E) in support of the United States Coast Guard's (USCG) eleven missions. The RDT&E mission is to provide innovative technologies, premier analysis and decision support to enhance operational performance and reduce acquisition risk across all Coast Guard (CG) missions. As part of the Acquisition Directorate under the RDT&E Program Office (CG-926), the RDC engages in research and technology demonstrations that affect all corners of the Coast Guard enterprise.

The Idea Submission Review (ISR) process continues to be a strong success in how we shape our R&D efforts in support of Coast Guard Acquisitions and Operations. In December, we released ALCOAST 487/14, which invited all units and individuals throughout the Coast Guard to submit their R&D project ideas. In this same time frame, the Area Commanders also send out a message

inviting field elements and operators to submit their ideas. Now in its third year, over 100 unique issues were submitted and assessed in 2014 using the Strategic Project Portfolio Alignment (SPPA) approach. This approach assures transparency and rigor by employing multiple assessment criteria against operational utility, impact, and feasibility. This past year, the SPPA was accomplished using a mix of Flag Officers, Senior Executive Service members from CG, Department of Homeland Security (DHS), Army, Navy, National Oceanic and Atmospheric Administration (NOAA), and others. Third party benchmarking rated our R&D portfolios for both the past and coming year as being well-balanced and strong. Although the ISR is a deliberate annual project idea collection event, Coast Guard members can submit ideas throughout the year via the RDC Portal Page at <https://cgportal2.uscg.mil/units/cg9/2/6/rdc/SitePages/SupportRequest.aspx>.

At any given time, we are working on 70 to 80 different projects for the Coast Guard and our partners. We have many partnerships with the private sector in the form of Cooperative Research and Development Agreements (CRADAs) under the Technology Transfer Act and with other government agencies and laboratories. The Coast Guard retained its own research center when we moved to the Department of Homeland Security (DHS), in part because Coast Guard mission research remains essential in support of the service's traditional missions. We also maintain strong business relationships with many DHS Science and Technology (S&T) Divisions in the collaboration of maritime security research. We produce a Quarterly Status Report that summarizes all of our project objectives and deliverables, and identifies who our sponsors and stakeholders are.

Our biggest asset is the government staff with project management and technical skills. Military personnel bring their operational expertise to the RDC and work closely with the civilian scientists and engineers on projects that help close capability and knowledge gaps. Together, they offer a powerful understanding of challenges that are applied to reduce the risk and raise the value of introducing new technology into Coast Guard missions. I believe the RDC's collective flexibility, depth of technical skills, and project management discipline is unmatched. The RDC knows how to test and evaluate new capabilities and offer critical support

Change of Command



Captain Alan Arsenault turned over command of the RDC on 27 June 2014 to Captain Dennis Evans in a ceremony at Fort Trumbull State Park.

with pre-transition evaluation of the most promising technologies.

My personal focus is always on R&D support of the Coast Guard's eleven statutory missions. We do not simply conduct technology evaluations or research and develop new ideas. While we do those things, I recognize those efforts are only valuable in as much as they improve the performance, efficiency or effectiveness of at least one of the eleven top-line statutory missions of the Coast Guard. This philosophy is represented in part by the strong

operational sponsorship we require before any project is approved. The RDC is not in the business of simply playing with new toys. To that end, I am proud of our portfolio for the upcoming year, 2015. We are adding 18 new projects to our portfolio, replacing 15 projects, 7 Modeling and Simulation tasks and the 4 quick Rapid Evaluation and Analysis of Critical Technologies (REACT) studies that we delivered in 2014. Each of these new projects complement our existing portfolio, deliver strong Return-on-Investment (ROI) to the American taxpayer and seek to improve the operational performance of Coast Guard missions.

The Coast Guard faces many future challenges, including new responsibilities, emergent threats, shrinking budgets, and the fast pace of technology development. My hope, in distributing annual reports, is that we will re-introduce who we are and reinforce that we are your go-to resource to investigate new technologies and to perform analysis that is needed to make the many hard choices the Coast Guard faces daily. The Quick Response Code (QRC) found on the back of this Annual Report will take you directly to our website where you can find our current project portfolio. I also invite you to review any of our available public domain reports, which can be found on the Defense Technical Information Center website at <http://go.usa.gov/fc4J>.

D. C. Evans, CAPT, RDC

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Coast Guard Missions

- *Ports, Waterways, and Coastal Security*
- *Defense Readiness*
- *Drug Interdiction*
- *Migrant Interdiction*
- *Other Law Enforcement*
- *Aids To Navigation*
- *Marine Environmental Protection*
- *Search And Rescue*
- *Ice Operations*
- *Living Marine Resources*
- *Marine Safety*

2014 VISITOR AND EVENT HIGHLIGHTS

RDC VISITS



Atlantic Area's (LANTAREA) Vice Admiral Parker visited the RDC in March 2014. Shown with RDC CAPT Arsenault.



Mr. Gary Rasicot, Office of Marine Transportation Systems and Ms. Kelli Seybolt, SES, the newly appointed Director of International Affairs & Foreign Policy with Captain Arsenault during their visit to the RDC.



Rear Admiral Thomas Ostebo visited the RDC in November 2014. Shown here with Captain Dennis Evans.

MSCOE RIBBON CUTTING



The **Modeling and Simulation Center of Expertise (MSCOE) Ribbing Cutting Ceremony** was held at the beginning of June 2014. Among other attendees, Congressman Joe Courtney, Rear Admiral Baffer and Ms. Claire Grady, SES, were present for this event.

The MSCOE provides decision-makers with access to campaign and mission-level tools that support fleet mix analysis, tactical mission engagement “what-if” scenarios, sensor optimization, resource allocation, and use of game-theory based scheduling tools. Although we are supporting the operations and maintenance of critical accredited tools and models the Coast Guard routinely employs, our analysts are not tied to tools, but more importantly, are tied to appropriate analysis techniques for the customer's particular problem. The MSCOE also leverages strategic partnerships with DHS S&T Centers of Excellence to enhance the quality and capability of RDC-delivered products. An added organizational benefit is that the MSCOE provides a career path for talented operations research personnel.

MERITORIOUS UNIT COMMENDATION

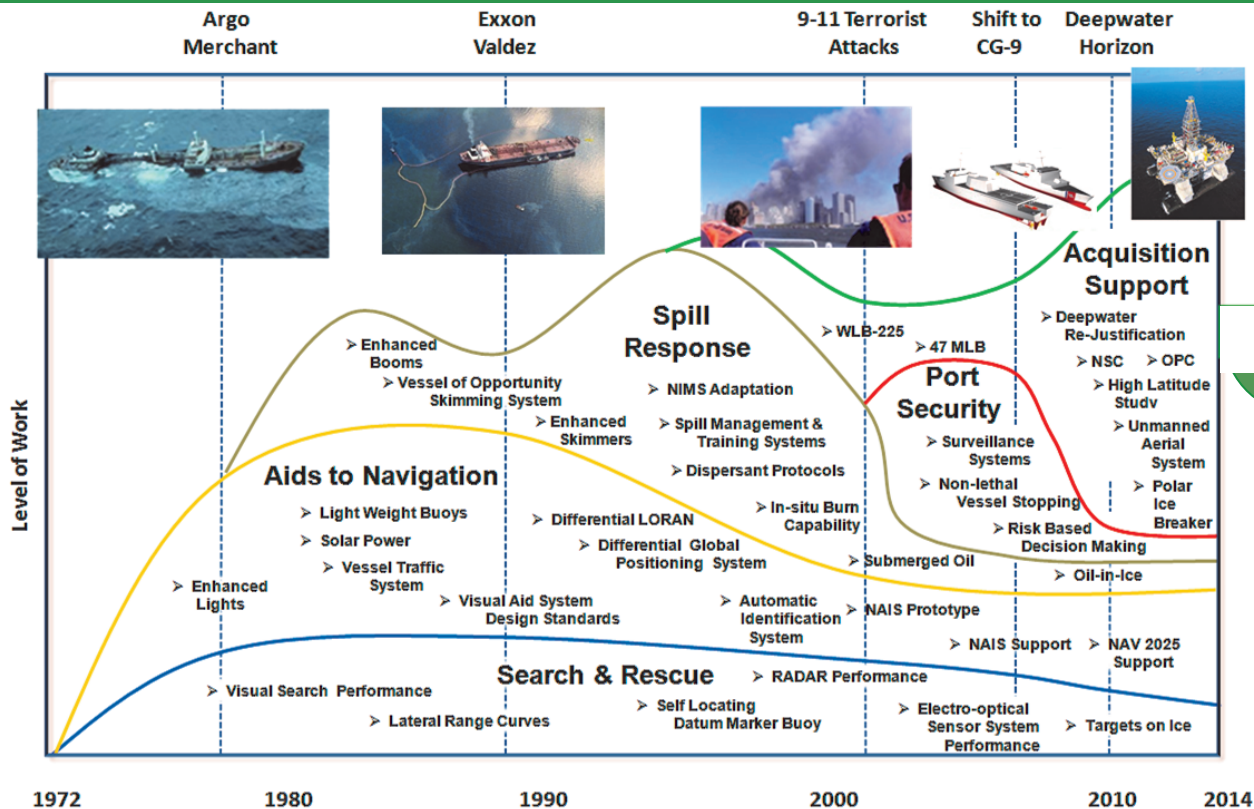


The RDC's Executive Director accepts for the RDC the Meritorious Unit Commendation for service from June 2011 to June 2014 during the Change of Command ceremony.

Continuing the tradition of providing valuable support to the Coast Guard, other government agencies, universities, and commercial partners, the RDC has leveraged partnerships through technical interchange meetings at its facilities in New London, CT and other venues throughout 2014.

THE RDC: A CRITICAL, AGILE COAST GUARD RESOURCE

RDC PROJECT PORTFOLIO PROVIDES IMPACT



Throughout its history, the RDC has continually demonstrated its agility and value to the Coast Guard, while repeatedly, and successfully, undergoing scrutiny by independent auditing organizations, to ensure that we continue to be a solid investment for the American taxpayer.

Founded in 1790, the U.S. Coast Guard has strived since its inception to use the latest advances in maritime tools and technology to increase its productivity and effectiveness in carrying out their wide-ranging missions. In 1968, the Coast Guard Office of Research and Development was established to assist the Coast Guard in executing projects associated with emerging technology that could benefit these missions. In order to increase performance and effectiveness, the Coast Guard combined the resources of the Field Testing and Development Center and some members of the Applied Sciences Division of the Office of R&D to establish the Research and Development Center. It was chartered in 1972 on the grounds of the University of Connecticut, Avery Point Campus. In 1989, as part of a major Coast Guard reorganization, the Office of Research and Development was merged with the Office of Engineering. The RDT&E Program was aligned with the Acquisition Directorate in 2007. In 2009, the RDC moved from Avery Point in Groton to its current home in New London.

Since its inception, the RDC has continuously been a valuable and agile asset to the Coast Guard as we face our greatest challenges. In the 1970's and early 1980's, our focus was on modernizing the service's aids to navigation (AtoN) and search and rescue (SAR) capabilities. Support of these missions continues to be an important part of the RDC portfolio. In the 1980's and 1990's, several high profile oil spills resulted in spill response becoming a major research area. In the late 1990's and the 2000's, the focus shifted to support cutter acquisitions and to improve the efficiency of a wide range of Coast Guard operations. Following the attacks of September 11, 2001, military and civilian RDC personnel immediately responded, providing staffing,

...THE RDC: A CRITICAL, AGILE COAST GUARD RESOURCE

WHAT WILL BE THE NEXT BIG SHIFT FOR THE RDC?

The illustration on the previous page depicts the RDC workload shifts over time. It is anticipated that new challenges and technology opportunities will forever shift the landscape of our focus. Example change drivers include cyber, big data, unmanned systems, and electronic Aids to Navigation (eAtoN). The efficiencies and conveniences that come with IT and big data come with growing threats including cyber threats that will require offensive capabilities to track down adversaries who want to harm or simply disrupt our missions and defensive technologies that create resilience in our Marine Transportation System. Unmanned systems are becoming an increasingly integral part of operations across the armed services, and given the congressional push for additional leveraging of unmanned assets, we expect to broaden our future focus on robotics. This technology has the potential to offer the Coast Guard a new low-cost Maritime Domain Awareness (MDA) tool. We are also on the verge of a paradigm shift in a long-standing mission area that has benefited from past years of the RDC research by now taking advantage of electronic navigation and Automatic Identification System (AIS) technology to reduce our reliance on the 50,000 physical aids that cost the taxpayer a great deal of money to service.

The RDC has a long, rich history of significant projects and products. Examples include:

- *Arctic Shield (2014)*
- *Operational Testing of ESS (2014)*
- *Unmanned Aerial Systems off NSC (2014)*
- *Optimizing Radar and Electro-Optical Sensors (2012)*
- *Non-lethal entanglement devices (2012)*
- *IN-SITU Burn tool box (2001)*
- *PISCES Pollution Incident Simulation, Control & Evaluation System (2000)*
- *Cutter Scheduling Assistance Program (1998)*
- *SLDMBs Self Locating Datum Marker Buoys (1995)*
- *Vessel of Opportunity Skimming System and High Seas Skimming Barrier (1990)*

expertise, and a big-picture look at homeland defense. Since that time, the RDC has been actively pursuing new products that will assist the Coast Guard in protecting our ports and enhancing homeland security. During the Deepwater Horizon oil spill, the RDC quickly stood up an Independent Analysis and Technology Assessment Program to provide technical assistance to the Incident Command on the evaluation of specific emergent technologies and the thousands of ideas received from the general public. The RDC contribution to this Spill of National Significance earned the RDT&E Program an Innovation Award for Management in 2011.

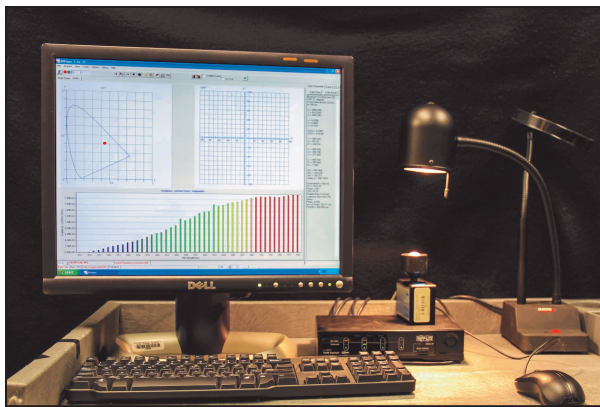
More recently, with the climate warming and subsequent receding ice in the Arctic, the Coast Guard called upon the RDC to conduct a High Latitude Study of future Coast Guard mission and resource requirements in this new priority operational area. This study has become the foundational basis for initiating a variety of Arctic initiatives, strategy, and the major acquisition of new 21st century capabilities (i.e., polar icebreakers) in this critical region of the U.S. Exclusive Economic Zone. In recent years, the RDC has also supported the Assistant Commandant for Capability (CG-7), the Force Readiness Command (FORCECOM), the Atlantic and Pacific Area Commands, and others with a wide variety of technology-based analyses and tasks.

The RDC's efforts are broad and varied, manifesting themselves by supporting the acquisition and regulatory processes and improving the efficiency and effectiveness of Coast Guard operations and resources. The RDC has on-site Photonics and AIS Laboratories and a Modeling & Simulation Center-of-Expertise. It also operates a Joint Maritime Test Facility (JMTF) in Mobile, Ala. The JMTF is the only facility in the world using ships for full-scale fire testing. RDC tenant commands include the International Ice Patrol (IIP) and Marine Safety Laboratory (MSL). The primary mission of the IIP is to alert any ships traversing the great circle shipping lanes between Europe and the major ports of the United States and Canada of the presence of any icebergs. The MSL is the U.S. Coast Guard's sole forensic laboratory for oil spills and is an operational unit that spun off from RDC oil identification chemistry research.

COAST GUARD OPERATOR FEEDBACK AND ASSETS ARE KEY INGREDIENTS TO RDC TECHNOLOGY EVALUATIONS

General Engineering Laboratory Support (GELS)

GELS came into being because the Coast Guard needed to purchase lights for navigational buoys that met maritime condition specifications. The RDC laboratory tests and measures these various forms of light (incandescent, fluorescent, xenon, laser technology, and more recently Light Emitting Diode (LED)) with the primary objective being conspicuity (a state of being very easy to see or notice).



The RDC GELS program collaborates with industry partners from concept through prototype stages to develop self-contained lanterns that do not require additional parts and demonstrate reliable functionality. These new lanterns reduce Coast Guard maintenance costs.

The GELS team supports other RDC projects with photonics expertise and often provides quantitative test data. Such projects include Alternatives to Pyrotechnic Signaling Devices which is looking to develop handheld rescue lights to replace flares, and measuring shipboard lighting to determine what, if any, cost savings could be realized by converting ship lighting to LED.



Automatic Identification System (AIS) Lab

The Acquisition Nationwide AIS (NAIS) Program Office allowed the implementation of NAIS in two phases. The Interim Receive (IR) System was com-



pleted in 2008. At that point, the C4IT Program Office assumed the responsibility

for IR System operations and for protecting and maintaining the integrity and performance of the network. The AIS lab includes critical equipment that is supplemented by our small research footprint on Fishers Island, NY. The second and current phase includes providing the expertise and capabilities needed to support and sustain the NAIS as well as support for the integration of the IR and Permanent Transceiver (PT) networks.



Although we have some lab facilities, the field is our primary lab space. We continue to send many RDC teams out to the field to lead complex technology demonstrations and studies that in 2014 included: oil-in-ice response testing as part of Arctic Shield; Cutter testing of a small unmanned aerial vehicles; testing of non-compliant vessel disabling technologies; and electro-optical and infra-red system operational testing against targets to support SAR sensor settings on our rotary wing aircraft.

FROM THE LAB TO THE FIELD



Arctic Shield 2014

A team of scientists from the RDC deployed aboard the Coast Guard Cutter (CGC) Healy during August for a month-long Arctic technical evaluation conducted in conjunction with the annual Operation Arctic Shield exercises. These exercises are executed by District 17 and are centered on maintaining an increased Coast Guard presence in the Arctic during the months of the year when the Northwest Passage over Alaska is open to vessel traffic. The purpose of the RDC evaluation was to demonstrate and evaluate capabilities and technologies to identify potential solutions to known operational challenges, as well as determine areas for future study to further improve Coast Guard operations in the Arctic.

The RDC partnered with multiple agencies, organizations, and academic institutions to bring together the knowledge, personnel, and resources necessary to accomplish the Coast Guard's research objectives specifically in the areas of boat operations, communications, navigational safety, and oil spill response.

For Arctic Craft investigations, the RDC collaborated with project sponsors and stakeholders to identify technologies and install them onboard CGC Healy's Arctic Survey Boat for assessment during the month-long patrol. The RDC assessed 18 commercial-off-the-shelf technologies for increased Coast Guard effective presence, which included: defoggers; multiple coolant, fluid, and battery heaters; a 3-D underwater imager; forward looking sonar; an underwater camera; an infrared camera; and streaming video equipment.

The RDC also evaluated Arctic communications coverage. Over the past year, the team modeled High Frequency (HF), Very High Frequency, and Ultra High Frequency coverage based on existing infrastructure. While onboard the CGC Healy, the team validated the results from communications coverage models and also identified key areas for future HF infrastructure to improve communications coverage. Additionally, U.S. Northern Command, with support from Lockheed Martin Corporation, assessed Mobile User Objective System (MUOS) satellite coverage at high latitudes. The team successfully and reliably transmitted voice, photos, movies, large documents and live videos at latitudes up to 74 degrees North utilizing portable antennas typically designed for stationary operations. The RDC predicts that the system would provide full bandwidth coverage up to the highest latitudes with the appropriate shipboard

Arctic Shield Technology Demonstration Partners

- *Coast Guard Seventeenth District*
- *Coast Guard Pacific Area*
- *Coast Guard Regional Dive Locker West*
- *Coast Guard Academy*
- *Coast Guard Office of Cutter Forces*
- *National Oceanic and Atmospheric Administration*
- *U.S. Northern Command*
- *Office of Naval Research*
- *Space and Naval Warfare Systems Command*
- *Cold Regions Research and Engineering Laboratory*
- *National Ice Center*
- *Oil Spill Recovery Institute*
- *University of Cambridge (UK)*
- *Marine Exchange of Alaska*
- *University of Washington Applied Physics Laboratory*
- *Department of Homeland Security Science, Technology, Engineering and Mathematics Internship Program*
- *Lockheed Martin*
- *Inland Gulf Marine*

... Arctic Shield 2014



antennas. In the summer of 2015, the CGC Healy plans to transit to the



North Pole and the RDC intends to continue to assess MUOS during that patrol all the way up to 90 degrees North.

To help improve Arctic navigation, the RDC entered a cooperative research agreement with the Marine Exchange of Alaska (MXAK) to leverage their AIS infrastructure to evaluate the system's capability to transmit Coast Guard electronic maritime safety information to mariners. During Arctic Shield 2014, aids to navigation identification information and geographic area messages were successfully transmitted, subsequently received, and viewed onboard the CGC Healy.

The RDC also continued to study techniques and technologies to improve oil spill response in ice. A 48-hour exercise was conducted to gain a better understanding of how oil moves in the marginal ice zone (an area extending from open water up to a mile into the ice pack). The RDC worked with the National Oceanic and Atmospheric Administration (NOAA) and AeroVironment (AV) personnel to deploy a small unmanned aircraft system (sUAS) to observe the movement of simulated oil for the assessment. The RDC, NOAA, and AV team successfully demonstrated flight deck landings and net capture recoveries as safer alternatives to water and ice landings in the Arctic.

Remote Operated Vehicles (ROVs) provided by various Coast Guard units and an Autonomous Underwater Vehicle (AUV) provided by the University of Cambridge (UK) provided underwater observations of the simulated oil. The National Ice Center, Space and Naval Warfare Systems Command, and the University of Washington's Applied Physics Laboratory provided additional technologies to help monitor ice and weather conditions throughout the exercise.

UAS off the NSC 2014

During December 2014, the RDC conducted a demonstration of the U.S. Navy's MQ-8B UAS aboard CGC Bertholf to fulfill sponsor objectives related to both dynamic interface testing and Concept of Operations (CONOPS) development:

- Obtain initial aviation facility certification for Fire Scout
- Safely launch and recover the air vehicle
- Complete dynamic interface – validate general pitch/roll/wind envelope for air vehicle
- Conduct line of sight flight operations out to 75 nautical miles
- Transmit electro-optical/infrared imagery and Automatic Identification System (AIS) data to a Ground Control Station (GCS) on National Security Cutter (NSC), as well as a separate underway surface asset
- Demonstrate communications relay to/from surface asset
- Expand dynamic interface
- Conduct radar demonstration

The Vertical Take-Off and Landing (VTOL) Unmanned Aerial System (VUAS) Flight Demonstration off the National Security Cutter (NSC) project was designed to expand Coast Guard research and operational experience with UAS capabilities in a maritime environment and to examine the effectiveness of VUAS in contributing to NSC mission performance.

The VUAS was operated by active duty USN personnel and managed by a demonstration team comprised of subject matter experts from the RDC and the Office of Aviation Forces (CG-711).

This endeavor was undertaken as a result of a 2008 Congressional appropriation that directed the Coast Guard "to determine the most effective UAS to

operate off the NSC," and concludes years of in-depth study, market research, and demonstrations with smaller UAS. This information will also buy down acquisition risk by providing knowledge on system integration, certification, and payload performance that can be applied to any ship-based UAS.



Organization

Organizationally positioned under the Coast Guard Acquisition Directorate, the RDT&E Program consists of two primary components: the Program Office (CG-926) located at Coast Guard Headquarters in Washington, DC and the Research and Development Center (RDC) located in New London, CT.



The Program Office provides programmatic oversight and is the lead for policy, strategic direction and communications. The Program Office also serves as the RDT&E Program's primary liaison with other program offices. CG-926 maintains an active strategic alignment and stakeholder outreach program that ensures the project portfolio is consistent with strategic goals and stakeholder needs under six main domain areas: Surface; Aviation; Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Acquisition Support and Analysis (ASA); Environment and Waterways; and Modeling and Simulation (M&S). These domains are aligned with the RDC's technical branches.

The RDC is the lead for the development and execution of the Coast Guard's R&D project portfolio. The RDC organization includes an Executive Director as well as Technical and Support Divisions that work together to execute the RDC mission. The Technical Division is responsible for planning and executing projects as well as providing science, technology and operational subject matter expertise. These experts include both military and civilian scientists, engineers, and analysts, many with advanced degrees in their respective fields. In addition to

their formal educations, the people assigned to the Technical Division have a vast wealth of Coast Guard-specific knowledge and experience. Many are recognized experts in topics such as Search and Rescue, Oil Spill Response, Ballast Water Treatment, AIS, Unmanned Systems, Arctic Operations, Marine Safety, Less-than-Lethal technologies, and Modeling and Simulation. The Technical Division is divided into six branches, based primarily on Program Areas.

The Support Division provides: informational services; internet/intranet support; office automation; safety and security support; shipping and receiving; timekeeping; accounting services; marketing and public relations; property management; and general administrative support for the RDC and CG-926 organization.

Coast Guard R&D contracting support is provided by 10 RDT&E-funded billets in the Contracting Division (CG-9128) that report to CGHQ but are co-located at RDC.

The 2014 RDC staff was comprised of 13 Military and 71 Civilian personnel. RDC building tenants include 10 Coast Guard Contracting staff, 26 contractors, 3 National Oceanic and Atmospheric Administration (NOAA) personnel, 18 International Ice Patrol (IIP) personnel and 9 Marine Safety Lab (MSL) personnel. The RDC is within close proximity to Station New London and the Coast Guard Academy .

RDC Personnel Spotlight

The RDC employs the best that the New England scientific talent pool offers. The New London facility costs are less than in larger metropolitan areas and the geographic separation from the Washington, DC Headquarters helps the RDC to serve as an independent agent for critical studies. A couple of young professionals describe their perspective on being part of the RDC:



LT Jeffrey A. Young

To me, being at the RDC means managing million-dollar project portfolios, leading diverse teams in the demonstration and test and evaluation of cutting-edge technologies that could revolutionize Coast Guard operations, and forging interagency partnerships to identify and pursue opportunities of mutual need. The RDC has put me in a position to leverage my operational experience to benefit RDT&E efforts while also providing an opportunity to expand my technology development leadership skills and stay connected to operations.

Prior to reporting to the RDC, I served as the Enforcement Chief at Sector Boston and the Weapons Officer onboard CGC Spencer (WMEC-905). Since joining the RDC, I have led efforts to explore the use of tactical data link capabilities in Coast Guard operations, test new technology radars to determine potential impact to mission effectiveness, and evaluate the efficacy of using satellite technology to conduct the International Ice Patrol's mission of detecting and tracking icebergs in the North Atlantic shipping lanes. I have supported efforts to identify and address ergonomic challenges to Command Center operations, validate sensor performance models, and identify alternative solutions for capabilities onboard National Security Cutter hulls 5-8.

The RDC exposes me to the challenges facing the Coast Guard, provides me an opportunity to observe the workings of our organization at the highest levels, and allows me the opportunity to work with national experts to innovate and think "outside the box" to address key questions that face the Acquisitions and Capabilities Directorates to meet the needs of the operators.



Alexander Balsley

I arrived at the RDC with a newly minted undergraduate degree in Civil/Environmental Engineering from Northeastern University with the understanding that I would rotate through each technical branch in order to become familiar with their current projects.

It would be an opportunity for me to better understand how diverse the CG's needs were. Only less than a month later, the Deepwater Horizon incident occurred. I was placed on a team to evaluate different types of technologies recommended to the RDC from the public (all citizens including academia and industry) to assist with the Gulf response and cleanup.

Four years later, I am managing two projects and have experienced professional growth in many ways. It is impossible to avoid enriching opportunities when working at the RDC. One is exposed to a multitude of projects on a daily basis and involved in communications with many peers not just within the CG network but also with other Government employees, people of academia and industry representatives. Through working closely with coworkers or discussing project ideas/needs with peers from other organizations at technical conferences, you consistently challenge your ability to be innovative. The military presence at the RDC reminds me of my purpose at the workplace, which is to serve and protect the public. Working directly with them also gives me a sense of pride in that the work I do is meaningful.

Being a project manager at the RDC is challenging as you are constantly working to expand your professional skills, including written and oral skills. As a deaf person, communicating technical information to other peers can be trying but the RDC has given me every resource I need to be successful, including sign language interpreters or other supporting technologies. My coworkers have been excellent mentors as they offer tips, advices and encouragements but also remind me to have fun!

Acquisition Support and Analysis (ASA)



Core Competencies include:

- *Requirements & Alternatives Analysis*
- *Human Systems Integration*
- *Mission Analysis*
- *Risk Analysis*
- *Life Cycle Cost Analysis*

The ASA Branch provides the Coast Guard and the RDC with expert skilled analysts armed with the right tools to produce analysis products that address specific questions for Coast Guard decision-makers. Some of the projects researched by the ASA Branch during 2014 include:



The **Polar Ice Breaker (PIB) Acquisition Support** project supported development of the Coast Guard PIB Operational Requirements Documents (P-ORD and ORD) as well as the Alternatives Assessment to assist decision makers with the acquisition of a new polar icebreaking capability.



The **Port Resiliency Decision Framework Toolkit (PRDFT)** was developed to provide port resiliency decision assistance for Sector Commanders, Captain of the Ports, and Port Authorities. Work included collecting requirements, identifying data sources and gaps, establishing a prioritized list of tool variables, and identifying key decision points. The three phases of the project include: (1) Develop an effective PRDFT in collaboration with Stevens Institute and other Centers of Excellence (COEs) (completed in 2014); (2) Develop and select high priority Port Resiliency Decision Tool(s) in collaboration with COEs (2015); and (3) Integrate Port Resiliency Decision Tool(s) developed under Phase 2 with Coast Guard enterprise systems (2016).

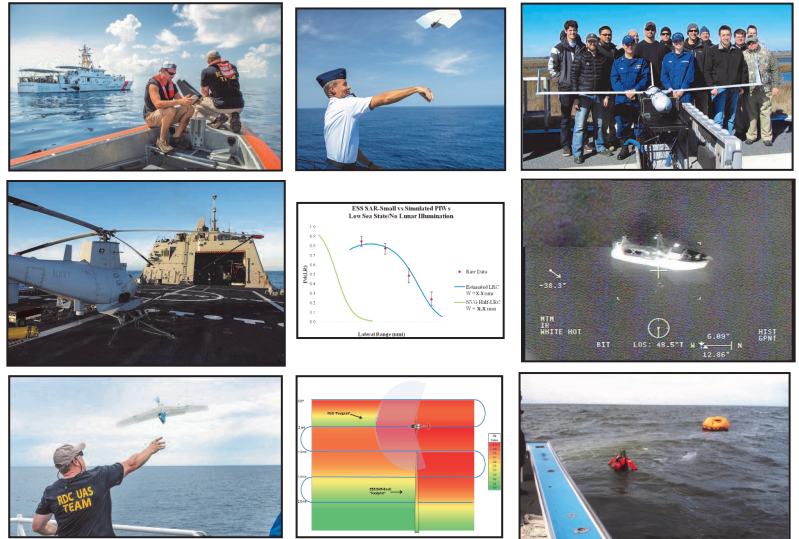


The project to **Develop a Game Theory Fish Patrol Schedule Model** will improve the efficiency and effectiveness of patrol scheduling in support of the Living Marine Resources mission. The efforts in 2014 successfully provided a baseline prototype and produced a model for chosen Coast Guard Cutters in a District.

Aviation

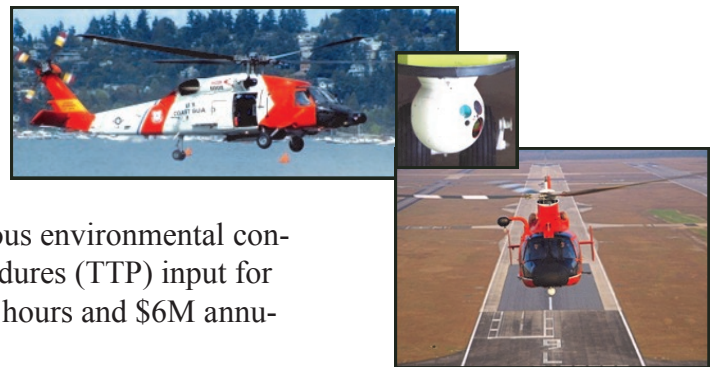
Core Competencies include:

- *Sensor Technologies*
- *Operational Performance Testing*
- *Analysis of Test Data*
- *Photonics Laboratory Testing*
- *Unmanned Aircraft Systems*
- *Performance Model Validation & Tuning*



The Aviation Branch develops, maintains, and applies competencies in mission-relevant test and evaluation, sensor and airborne platform technologies, performance measurement and analysis, and performance model validation. A few examples of project work executed by the Aviation Branch during 2014 include:

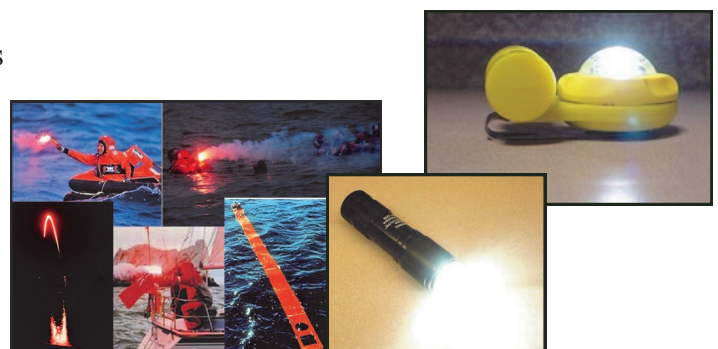
The **Operational Testing of Electro-Optical/Infrared Sensor System (ESS)** project validated the effectiveness of ESS operations and provided calibrated recommendations to improve current settings, configurations, and employment techniques on Coast Guard helicopters. Other efforts include improving the ESS Thermal Imager against typical SAR targets in various environmental conditions and providing the Tactics, Techniques, and Procedures (TTP) input for all ESS components. There will be savings of 700 flight hours and \$6M annually while ensuring operational accuracy.



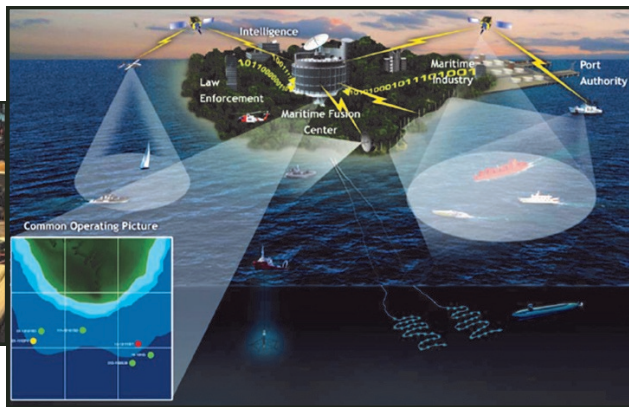
Analysis Support for CG Airborne Use of Force (AUF) Weapons Testing addressed the Coast Guard policymakers need for objective information concerning shrapnel /ricochet danger zones resulting from employment of AUF weapons and tactics by conducting a model evaluation and live fire test.



The **Alternatives to Pyrotechnic Distress Signals** project determined the suitability of potential alternatives to pyrotechnic visual distress signals and narrowed the optimal distress signal characteristics range by evaluating human subject response to laboratory-generated visual stimuli. It also expanded knowledge of signal conspicuity and identifiability through additional literature review and analysis of the nighttime maritime background environment.



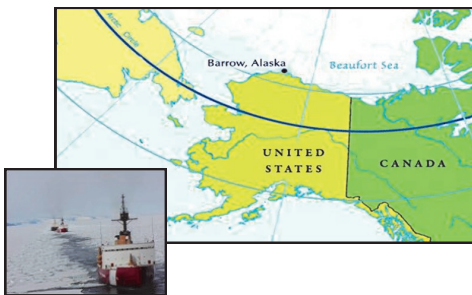
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)



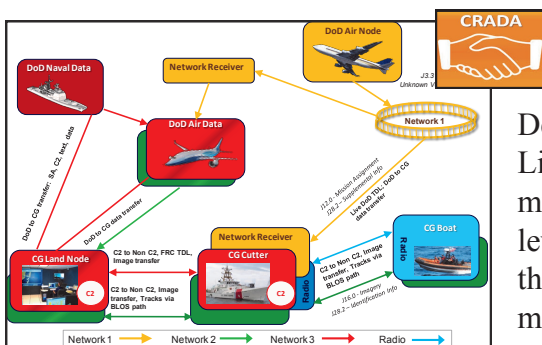
Core Competencies include:

- Maritime Domain Awareness
- Command & Control Information Technology Management
- Tactical Communications
- Communication System Analysis
- Intelligence, Surveillance, & Reconnaissance
- Navigation Systems
- Cyber Technologies

The C4ISR Branch conducts analyses, assessments, and integration in the three major areas of information technology, communications breakthroughs, and sensing technology. C4ISR, while not a mission of the Coast Guard, is critical to the execution of all eleven Statutory Missions. Some of the projects covered by the C4ISR Branch during 2014 include:



Arctic Communications modeling predictions were completed to determine a Coast Guard Cutter's ability to communicate by High Frequency (HF) radio communications throughout the Arctic region. The modeling results highlighted how the Radio Frequency (RF) physics of the Arctic affect range, clarity, and consistency over time. Field-based experiments in the Arctic using new satellite options and experiments with new antennas were conducted in various inland locations to identify ways to close coverage gaps.



Command/Control research in the form of a Joint Technology Demonstration explored the capabilities of employing Tactical Data Links (TDLs) to push and pull situational awareness information across multiple Coast Guard and DoD platforms accessing multiple security levels. Both capital and non-capital Coast Guard assets participated in the demonstration and were able to see all relevant situational and command & control information.



Mobile Technology research is improving the efficient collection and integration of information during large-scale "Incidents of National Significance" (IONS). Combining tablet technology with a novel mobile ad-hoc network, the C4ISR Branch continues to refine ways to better facilitate response and coordination of multiple crews covering different areas and tasked with different jobs during large scale incidents.

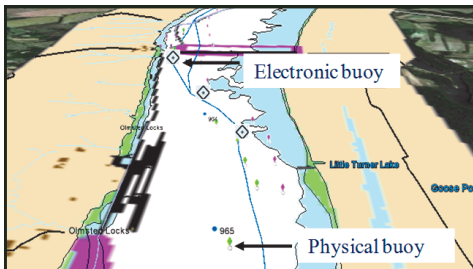
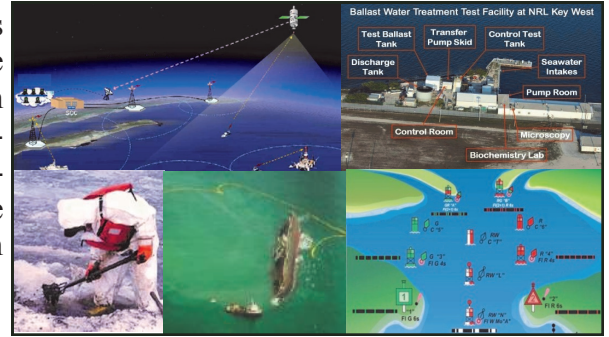
Environment and Waterways (E&W)

Core Competencies include:

- *Navigation Systems*
- *Environmental Protection*
- *Spill Response and Detection*
- *Ballast Water Standards*

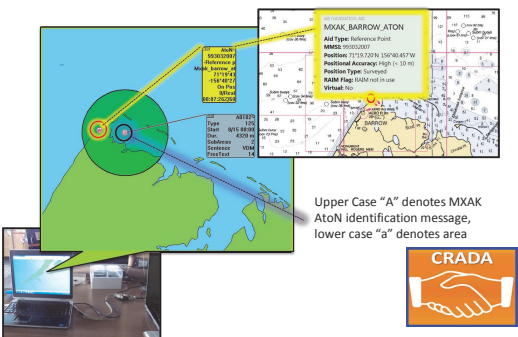
The E&W Branch provides technical expertise in the areas of Aids to Navigation (AtoN), pollution prevention and response, non-indigenous species, and the Automatic Identification System (AIS).

A few examples of project work executed by the E&W Branch during 2014 include:



The **Western Rivers Electronic Navigation (e-Nav) Technology Demonstration** is investigating how providing navigation information linked text messages via AIS actually helps users. Types of information include AtoN, environmental, geographic, and waterways management.

The **Arctic Navigational Safety Information System (ANSIS) Functional Design** project documented the mutually-agreed-upon design of the prototype system for near shore ANSIS which, once fully operational, has the potential to enhance mariners' capability to identify, assess, and mitigate navigational risks, and improve CG's MDA in the Arctic Region. The RDC established a three-year (renewable) CRADA with the Marine Exchange of Alaska in order to define, develop, test, install, and monitor a next generation navigational safety information system for the Arctic region.

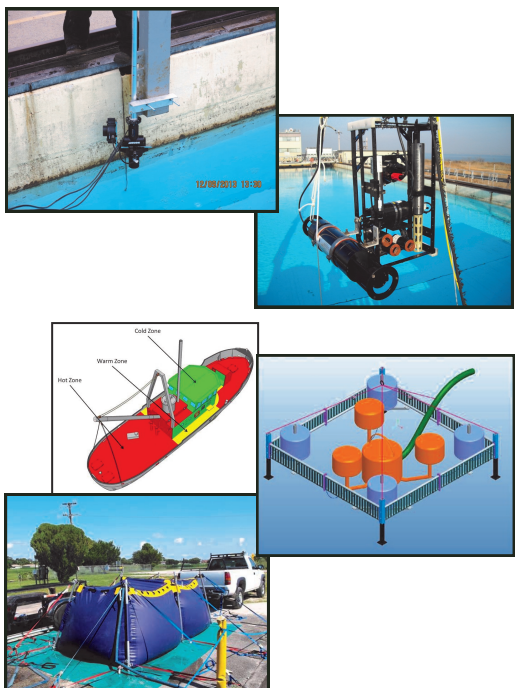


Upper Case "A" denotes MXAK AtoN identification message, lower case "a" denotes area



The first part of **Detection and Mitigation of Oil within the Water Column** project focused on the development of detection systems to identify and track subsurface oil spills within the water column. Two prototypes (optical and sonar) were tested by releasing oil at the National Oil Spill Response Research and Renewable Energy Test Facility in Leonardo, New Jersey. The second portion of the project focuses on developing a technology, technique, or strategy to reduce the impact of oil within the water column on the surrounding environment or manmade structures.

The **Response to Oil in Ice** project includes a group of methodologies to minimize the damage to the environment caused by oil spilled in extreme cold regions of the Arctic and Northern United States. Efforts include development of equipment and techniques that can be used to detect, track, and recover oil in ice filled waters in all conditions and a series of demonstrations in the Great Lakes and the Arctic.

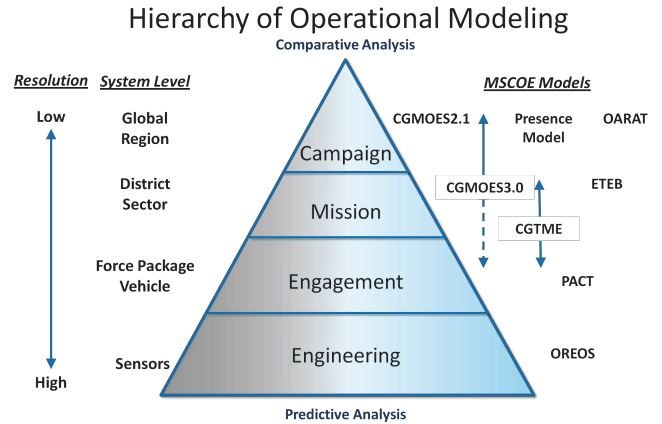


Modeling & Simulation Center of Expertise (MSCOE)

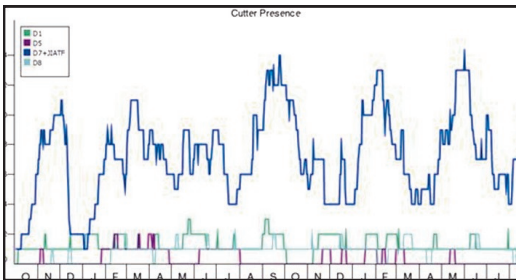
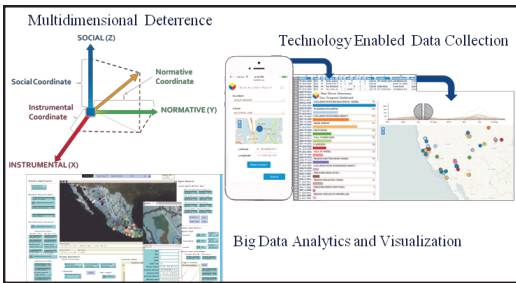
Core Competencies include:

- *Campaign Strategy Analysis*
- *Tactical Simulation*
- *Sensor Performance & Data Analysis & Visualization*
- *Validation & Verification*
- *Optimization*

The MSCOE provides the Assistant Commandants for Acquisition and Capability with a core competency for analysis, modeling and simulation by investigating and developing modeling approaches that pro-



vide more efficacy and efficiency for acquisition decision-making such as Fleet Mix Strategic Analysis, Tactical Force Package Analysis, Sensor Performance Analysis, Data Repository, Analysis, and Visualization. Examples of 2014 MSCOE projects include:



Data Driven Multidimensional Deterrence Measurement

Models applies advanced modeling algorithms to affect deterrence. The primary objectives of this effort include developing a strategic framework that identifies and defines the multiple dimensions of deterrence which, regulate social identity group attitudes and behaviors as well as a proof-of-concept modeling tool (Deterrence Impact Modeling Environment (DIME)) that provides mission planners and operators with a visually-based, data driven, analytic capability.

The **Coast Guard Operational Effectiveness Simulation (CGMOES) Next Generation** project addresses the need for an easy-to-use, streamlined capability for routine Coast Guard-wide asset allocation and force structure decision support. The overall project objectives include providing quick turnaround answers to questions driven by Congress regarding eliminations of asset classes and changes in mission priorities, etc. to senior leadership.

Not all of the work done by the MSCOE are full projects but are referred to as **Tasks**. Some of these examples include: **VV&A of OREOS, PROTECT rollout - Western Rivers, Post Hurricane Utility Analysis Methodology Review, WRFMAT Fleet Size Excursions, OPC Sea State Study, sUAS Modeling for Project 7804, OPTIDE Support, Plum Island PROTECT, Aviation Force Siting Optimization Study, Implementation of NEXTGEN Campaign Model Tool**, as well as others.

The MSCOE has a team with core skill sets augmented by a contracting mechanism that allows a quick turn around on Short Term Analysis Tasks.

Surface

Core Competencies include:

- *Boarding Team Tools*
- *Compel Compliance*
- *Sector and Port Security Tools*
- *WMD Countermeasures*
- *Alternative Energy*
- *Arctic Capabilities*



The Surface Branch provides comprehensive research, development, analysis, and testing support to Coast Guard programs in Arctic missions, vessel technology, port security, law enforcement, alternative energy, and weapons of mass destruction. Examples of Surface project work accomplished during 2014 include:

The **Operational Testing of Alternative Fuels** addresses the means to meet mandated future greenhouse gas emissions and energy reduction targets. Efforts include (1) identifying the benefits of using alternative, lower carbon footprint diesel fuel and gasoline blending agents in Coast Guard boats based on materials, bench, field and operational tests and (2) benefits from non-ethanol fuels in the maritime environment. The Surface Branch completed field testing of biodiesel in 2014 and will report on bio-butanol testing in 2015.



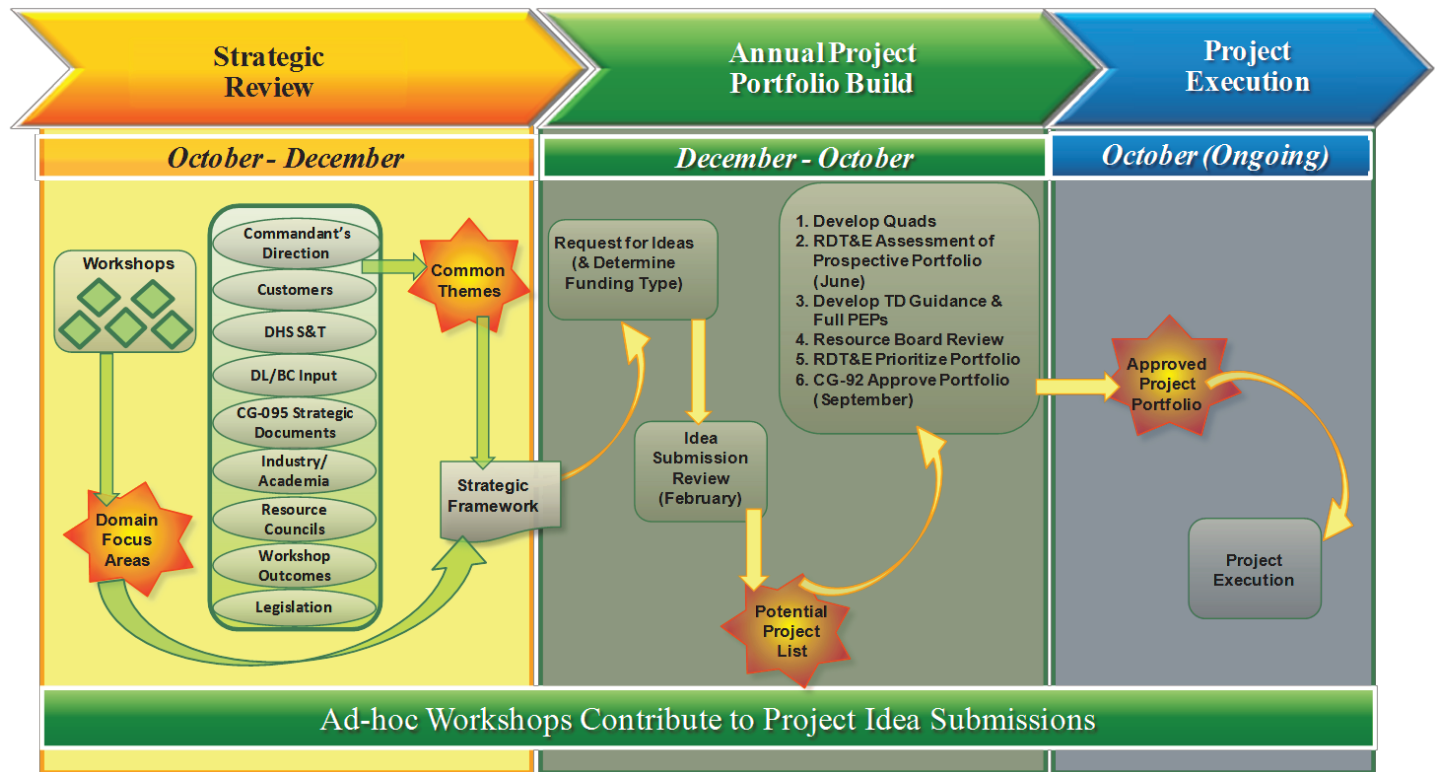
The **Maritime Trace Narcotic Identification/Verification** project provided Narcotic Identification/Verification (ID/V) capabilities to meet National Drug Control Strategy (NDCS) performance goals. The impact for boarding team members is a more effective and efficient narcotic identification/validation capability for use during maritime counterdrug missions.



The **Non-Lethal Impact Munitions (NLIM)** project will provide the Coast Guard with the capability to enforce maritime law with non-lethal systems. The results of this work contribute to the selection of non-lethal weapons as well as to the selection and prioritization of Key Performance Parameters (KPP) and Key System Attributes (KSA) for non-lethal weapon systems for the Coast Guard fleet. In 2014, the Surface Branch tested and reported on boat-to-boat non-lethal impact munitions on the water.



Strategic Project Portfolio Alignment (SPPA)



The RDC executes a robust portfolio evaluation methodology that strategically positions the Coast Guard's science and technology investments. The six Coast Guard Strategic Imperatives for its R&D portfolio are: Impact, Transition, Technical Positioning, Strategy Alignment, Partnerships, and Management Risk.

Strategic Review Phase

Feedback from workshops focusing on specific Domain Areas and information gleaned from various Stakeholder Resources (Commandant's Direction, Customers requests, DHS S&T, Domain Leads, Coast Guard Strategic Documents, Industry and Academic Institutions, Resource Councils, and Legislation) are grouped into Common Themes. The grouped information creates the Strategic Framework that informs the Request for Ideas, part of the second phase of the SPPA process.

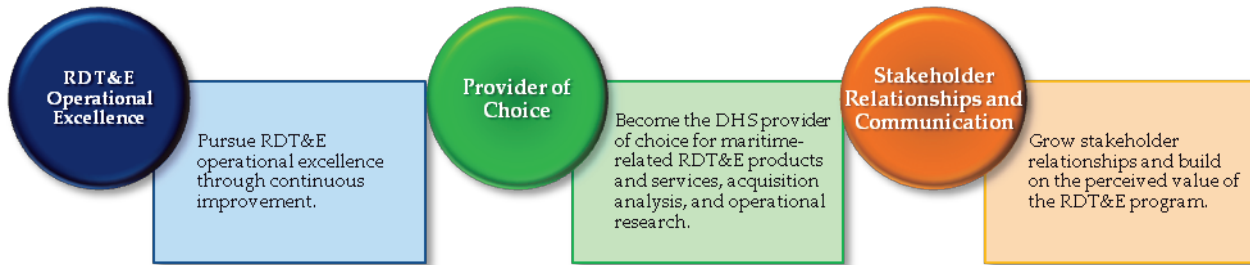
Project Portfolio Build Phase

This is the key phase of the SPPA process and includes the Idea Submission Review (ISR) and Assessment of Prospective Portfolio (APP). The ISR solicits ideas from Coast Guard stakeholders including the field and asks that representatives from Headquarters sponsor offices as well as the Areas vote on all ideas determined to be appropriate for RDT&E funding. The ISR is the first opportunity to get enterprise visibility of new project ideas in the Coast Guard's RDT&E portfolio and is the first step towards transition of a research product into Coast Guard operations.

Project ideas are scored on a scale of 1 to 10, with 10 being the highest, against the four criteria: potential impact; transition likelihood; customer or sponsor buy-in; and alignment with strategy.

Project ideas are ranked in numerical order based on their raw score, which determines the rank the project idea receives. Project ideas with high score ranks are included in the Assessment of Prospective Portfolio (APP) Review. The APP review involves 13 measures and is based on best practices used in DHS portfolio management. Senior leadership from internal and external organizations participate in the portfolio review process, and in 2014 these included external leadership from DHS S&T Border and Maritime Security Division (BMD), Domestic Nuclear Detection Office (DNDO), Office of Naval Research (ONR), and NOAA on the voting panel.

The big picture bubble chart (on the next page) shows the positioning of the FY2015 portfolio. The upper right quadrant is hi-impact and low risk – a good place to be. However, even as a primarily applied research R&D organization, it is acceptable to have projects in the upper left quadrant of hi-impact and hi-risk. In fact, that is



The RDT&E Programs Top Three Goals over the next three years are the main focus of our Strategic Plan. These goals enable successful operational capacity and mitigate risk across all eleven Coast Guard Missions.

where many of the new project starts reside. You will note a few projects in the lower left quadrant. These projects fall into the category of earmarks, mandated projects, or are included because of new understanding of requirements or of the technology being investigated that was not factored into the initial scoring done at the APP Review. The RDC has performed this review three years in a row and each time has been independently benchmarked as a well-balanced portfolio. The take away here is that the taxpayer is getting good bang for their buck with RDC project investments.

Project Execution Phase

The Project Execution Plan (PEP) is prepared in response to a support request and is the means by which a project/task is initiated and approved. A product may be a thing, information, or service (e.g., software, hardware, presentations, reports), or a combination of the three that the RDC has agreed to develop and deliver to the customer to address the identified problems and objectives of the project.

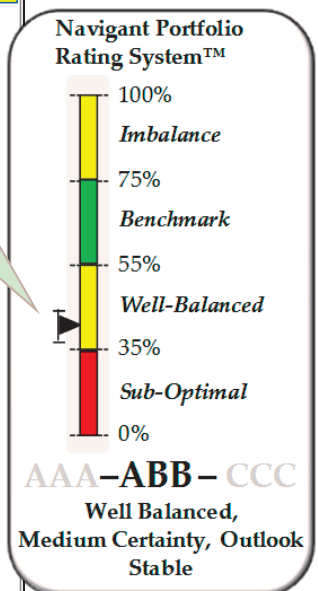
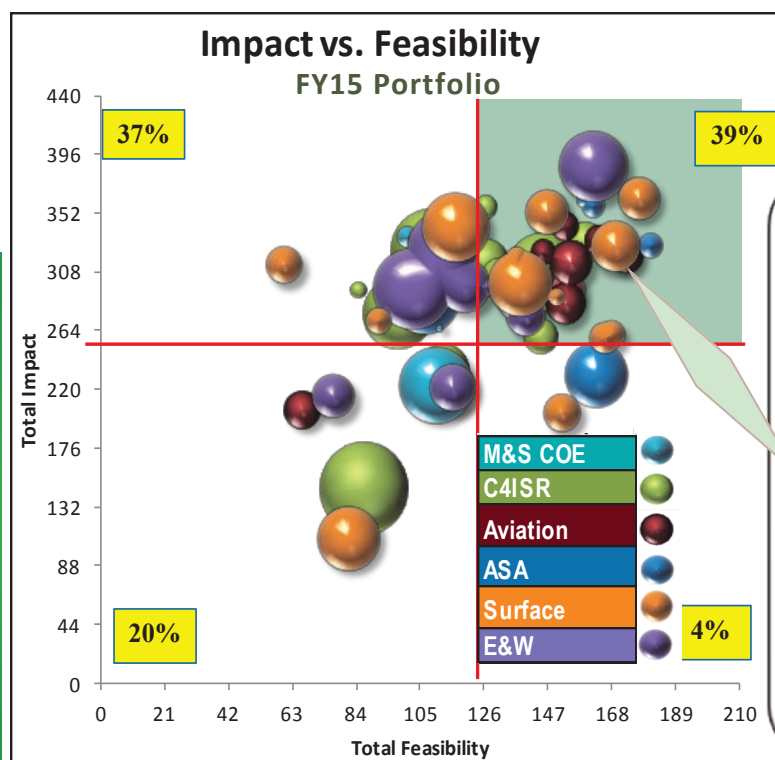
RDC projects require Monthly Status Reports to provide timely and accurate project and task status information to RDC customers.

As a means of obtaining feedback on the quality, timeliness, and utility of the products delivered as well as the overall quality of the execution of RDC projects, every active project implements at least one Product Evaluation Tool (PET) each year. PET metrics are reported in monthly Technical Division Most Efficient Organization (A76) reports.



The RDT&E Program was the recipient of the Management Innovation Award for its SPPA process in 2014.

The bubble chart represents the positioning of the 2015 portfolio. The upper right quadrant represents high impact and low risk projects. The bubble diameters represent the amount of funding required to complete the project.



Projects: Past and Future

2014 Accomplishments

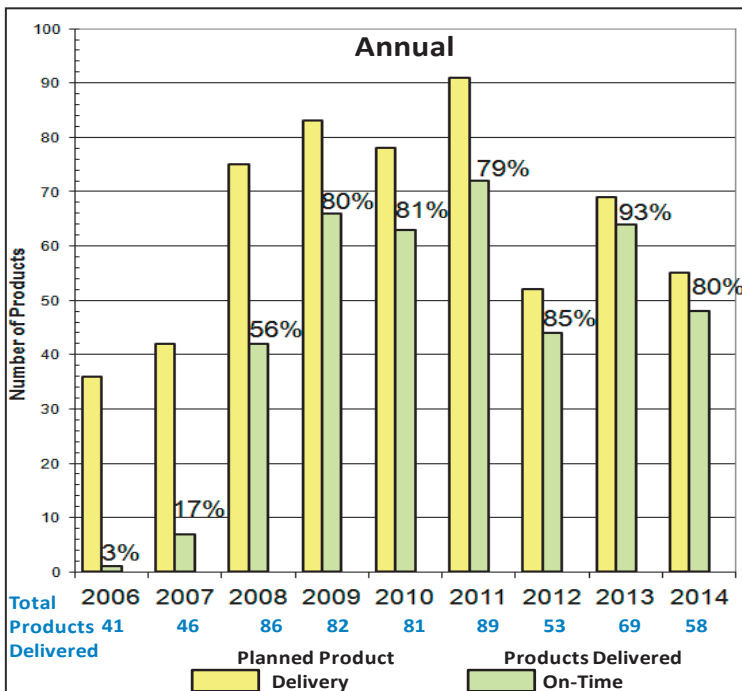
Completed 15 Projects, 7 MSCOE Tasks, and 4 REACT Studies

- 128 PEPs Approved Since Beginning of 2014
 - 24 New
 - 23 Preliminary
 - 81 Updated
- 20 Proposals Submitted
- 58 Products Delivered
- Opened Modeling and Simulation Center of Expertise (MSCOE)
- Supported Department of Justice & Office of Claims and Litigation (CG-0945) in Deepwater Horizon Litigation
- Implemented Airborne Radar Lateral Range Curves
- Completed Field Test of ESS
- Completed Field Test of sUAS
- Modified Recalibration Procedures for ESS
- Provided Recommendations for Update of Home-port Internet Portal

“Our biggest asset is the government staff with project management and technical skills and our military personnel who bring their operational expertise to the RDC and work closely with the civilian scientists and engineers on projects that help close capability and knowledge gaps. Together, they offer a powerful understanding of challenges that are applied to reduce the risk and raise the value of introducing new technology into Coast Guard missions. I believe the RDC’s collective flexibility, depth of technical skills, and project management discipline is unmatched. The RDC knows how to test and evaluate new capabilities and offer critical support with pre-transition evaluation of the most promising technologies.” - CAPT Evans.

Examples of Planned Projects for 2015

- Mass Migration Planning Tool Development
- DoD Technology Foraging Assessment for Coast Guard Missions/Capability Gaps
- Expand the Use of Unmanned Assets to Non-MDA Missions
- Tactile Situation Awareness System
- Coast Guard Fixed Wing Covert Study
- Prototype Hoax Location System Development
- Distributed Aperture System (DAS) Evaluation
- Automatic Transport of SAR Patterns
- Tablet Technology for Operational Efficiency with Improved Data Capture for Trend Analysis
- Develop Environmentally Friendly Buoy Mooring System
- Robot Capabilities Requirements and Alternatives for National Strike Force Response Support
- Mariner Situational Awareness
- Develop Innovative Counter Drug (CD) Interdiction Patrol Tactics



Impacts and Return on Investment (ROI)

EXAMPLE PROJECTS

Chicago Sanitary and Ship Canal (CSSC) Marine Safety Risk Analysis

- The invasion of non-indigenous species into our waters through ballast water discharges causes billions of dollars worth of damage to coastal infrastructure and fisheries. District 9 asked the RDC to characterize the electrical hazard exposure presented by electric fish barriers in the CSSC to waterway users and their rescuers. RDC quantified the risks by developing a one-of-a-kind mannequin that represented the electrical resistive properties of a human which was then towed across the electric fish barriers to map the hazards. The outcome included the implementation of new protection procedures. This past year we completed a comprehensive risk assessment that is providing the basis for regulatory guidance to ensure safety of life and property in concert with effective prevention of an Asian Carp invasion into the Great Lakes ecosystem.



properties of a human which was then towed across the electric fish barriers to map the hazards. The outcome included the implementation of new

protection procedures. This past year we completed a comprehensive risk assessment that is providing the basis for regulatory guidance to ensure safety of life and property in concert with effective prevention of an Asian Carp invasion into the Great Lakes ecosystem.

Night Vision Used by Coast Guard Coxswains

- A comprehensive investigation of advances in night vision technologies indicated significant improvements in key areas such as field of vision and depth perception beyond current Coast Guard fielded devices. The increased capabilities in nighttime visibility for all crew members



for all crew members would subsequently save both civilian and Coast Guard operator lives. A technical refresh project has been initiated. A new project start in 2015 will take the next step in field testing these system advances.

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Shipboard Small UAS (sUAS) Capability Demonstration

- The project successfully demonstrated the contribution of sUAS capabilities in supporting NSC mission execution, including the prosecution of an actual at-sea contraband seizure. Various sUAS payloads were tested including electro-optical (EO), infra-red (IR), nano-SAR, and automated detection software. The confluence of progress toward UAS integration into national airspace, evolution in sensor miniaturization, learning how they can be integrated into operations through field testing, and decreasing costs will make the sUAS solution an attractive asset to integrate into the Coast Guard's toolkit.

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Cutter Boat Video Recorder - The use of video recording throughout the entire intercept and boarding evolution will improve conviction rates by providing detailed documentaries of Coast Guard actions during intercept and subsequent boardings.

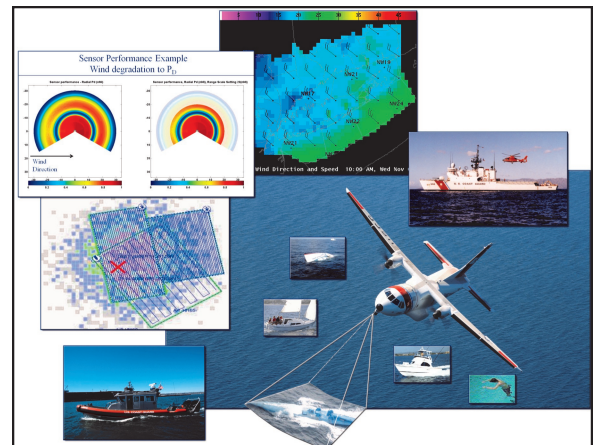
Cost Benefit Analysis of Boat Lifts - Results obtained from this in-water evaluation of various manufacturers' boat lifts installed at Coast Guard Stations produced the business case recommendation not to pursue boat lifts as a Coast Guard-wide solution because the savings are not there. This decision will avoid \$22 million in procurement costs of lifts for 746 Coast Guard boats.

Joint Non-Lethal Weapons Directorate Small Vessel Entanglement

- Provides Coast Guard Law Enforcement with a new tool for defeating a very adaptive adversary. Once the Small Naval Arresting Rope Entangler (SNARE) is deployed, any vessel evading law enforcement action can be stopped while preventing injuries and loss of life to the crew and no permanent damage to the boat.

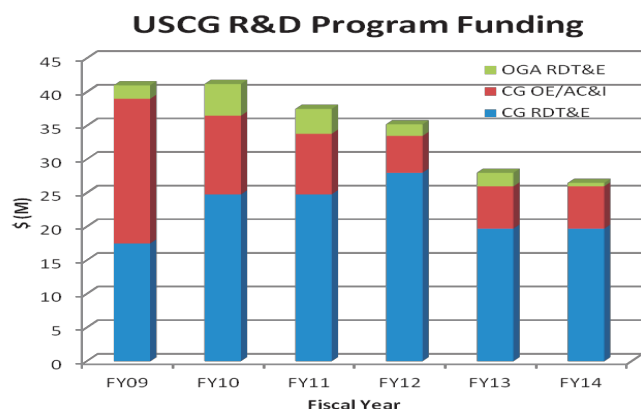
Optimizing Radar and Electro-Optical Sensors (OREOS)

- Use of this tool saves hundreds of thousands of dollars by supporting the determination of predicted sensor performance without the need to conduct expensive at-sea field testing every time a new sensor is acquired.



Resources

2014 RDC PORTFOLIO FUNDING DISTRIBUTION



The core resource the RDT&E Program brings to every project is our staff. Behind our high-performing staff are the RDC's project management and financial processes. Our practices and processes allow the Support Division to work closely with the technical staff to determine the appropriate path for all kinds of projects, ensuring we follow appropriation law and use the proper execution vehicles. Our financial team monitors and reconciles all transactions regardless of the source of funds, ensuring timely expenditures and recovery of funds. Our project and financial management processes enable us to provide prompt and accurate responses to the numerous data calls we routinely receive.

The Program receives an annual RDT&E appropriation. In 2014, this was \$19.3 million to cover staff and all RDT&E project execution costs. While the majority of the RDC portfolio consists of RDT&E projects and funds, we are more than the sum of appropriations. The RDC collaborates with industry through CRADAs and receives funding from the Coast Guard Operating Expense (OE) and Acquisition, Construction, and Improvements (AC&I) appropriations, as well as from will work with other government agencies via Reimbursable Agreements. Our financial business model allows us to partner with other agencies in efforts that will benefit the Coast Guard, especially with projects that will have a positive impact towards the eleven top-line statutory missions.

The figure at left shows the RDT&E appropriations and reimbursable funding provided by other government agencies for the last six years.

We are able to keep the Coast Guard advised of high-potential science and technology related opportunities, and deliver high quality, well-targeted research and development products by leveraging technology through partnerships with other government agencies and through-out the research community. This leverage allows us to optimize our R&D efforts (addressing a broader range of Coast Guard research gaps and in a time-frame that we could not accomplish with our annual appropriations alone); and tap into technical expertise not found within the Coast Guard.

Look For CRADA



Cooperative Research and Development Agreements (CRADAs), are authorized by the Federal Technology Transfer Act of 1986. The primary purpose of a CRADA is to promote the transfer of commercially useful technologies from Federal laboratories to the private sector for a public or commercial purpose or use by performing cooperative and mutually beneficial research and development.

Active CRADAs during 2014:

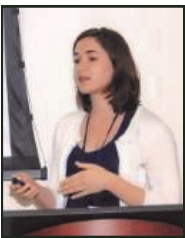
- *Engility: Joint Technology Demonstration for Tactical Data Links Range Enhancement*
- *General Dynamics 4C Systems: Incidents of National Significance*
- *Marine Exchange of Alaska: Arctic Navigational Safety Information System*
- *UrsaNav: Wireless Precise Time*
- *Operational Testing of Alternative Fuels*
 - *Honda*
 - *Cummins*
 - *Mercury Marine*

Science, Technology, Engineering, and Mathematics (STEM)

DEPARTMENT OF HOMELAND SECURITY (DHS) STEM

Homeland Security (HS-STEM) Internship Program

The RDC is re-engaging its outreach efforts to attract the next generation of STEM employees interested in solving maritime challenges in DHS. In 2014 we explored the national HS-STEM Summer Internship Program that provides undergraduate juniors, seniors, and graduate students the opportunity to work with homeland security professionals and researchers for up to ten weeks during the summer. This year's internships were successful in providing positive experiences to students and in producing useful products to DHS. As a result, the RDC is soliciting for more interns in 2015.



Ms. Shannon Smith was assigned to the C4ISR Branch to conduct research on the use and applications of underwater technology including sonar, unmanned underwater vehicles, underwater electro-optics, underwater information systems, and sensing technology. She

concluded:

- Underwater technology has the capability to enhance the 11 statutory missions
- Coast Guard's need to understand underwater technology is growing
- A program for education, research, and development purposes is indicated

Shannon is from Annandale, VA and recently completed her second year at Case Western Reserve University in Cleveland, OH. She is studying Applied Mathematics and Music Performance on the viola.



Ms. Caitlin Sinclair worked with the Surface Branch to investigate how to motivate compliance in the areas of boating behavior, emergency signals, and obedience to authority. She concluded:

- Motivating compliance requires a working knowl-

edge of neurological and social factors.

- Coast Guard crews should be provided with equipment that will allow them to confidently establish their presence so they can make informed decisions about escalating force in the event of an exclusion zone breach.
- Additional psychological information should allow crews to understand and influence the public's perception of the Coast Guard so they can shape communities that will support their security efforts.

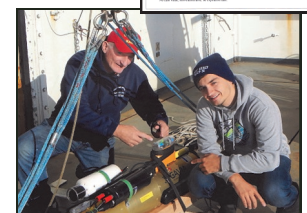
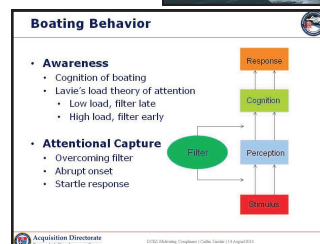
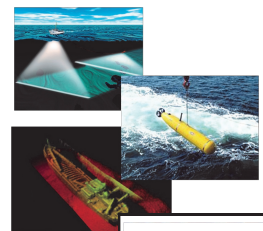
Caitlin is from Carson City, Nevada. In the fall, she will begin her senior year at Gonzaga University in Spokane, Washington where she studies Psychology and ship.



Mr. Anton Yanchilin worked with the Surface Branch on Arctic Technologies Evaluation. In addition to learning about the technologies being tested there, he worked with the NOAA representative to produce a

data management plan for the work being accomplished during the 2014 technology evaluations.

Anton is entering his third year at Creighton University, Omaha, NE, studying Applied Physical Analysis and Renewable Energy Technology with a minor in Computer Science.



... Partnerships

DHS OFFICE OF UNIVERSITY PROGRAMS (OUP)

Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Office of University Programs (OUP) Technical Interchange Meeting – Planning for Transition

The RDC hosted a Technical Interchange Meeting (TIM) in July 2014 to discuss the process for transitioning S&T OUP products to the Coast Guard. Participants included representatives from the RDC, DHS S&T, Coast Guard HQ and Area sponsors, and OUP Centers of Excellence (COEs).

Although collaborative knowledge products have been successfully transitioned and used in the Coast Guard organization, it has been more difficult to transition technology-based prototypes. The objective of the TIM was to develop a shared understanding of transition challenges and processes to increase the likelihood of successful transition of inter-Department and Academic collaborative investments.

Key take-aways from the meeting include suggestions for aligning the COE research and technology development processes with the Coast Guard acquisition governance and project approval process. Good progress was made in creating a transition alignment process.

The RDC is committed to this relationship. We created a COE Coordinator collateral position to work with OUP and the RDC liaisons to the university centers. In recent years we've been cultivating new partnerships and are involved in writing their funding opportunity announcements, participating in their stakeholder meetings, and executing projects with lead universities using DHS basic ordering agreements. As a result of our active involvement and as a component of DHS, OUP has awarded a new Coast Guard-centric Center for Maritime Research cooperative grant that will focus on MDA and emergent Arctic research needs. The RDC is well-positioned to serve as a trusted agent for these Coast Guard-related research and transitions.

Example COE projects at different stages of research and development include:

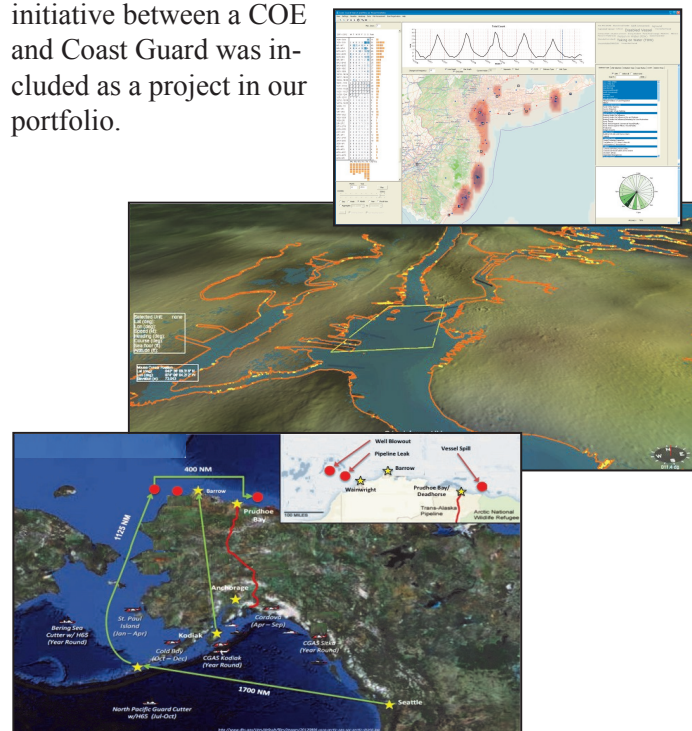
Coast Guard Search and Rescue Visual Analytics (cgSARVA): The goal was to develop a risk assessment visual analytics system that enables a thorough review of all search and rescue cases completed by each Coast Guard sta-

tion and the analytics to determine the potential increase or decrease in risk with reallocation of available resources. This tool was accredited with help from the RDC and used during Hurricane Sandy.

Port Resilience Operational /Tactical Enforcement to Combat Terrorism (PROTECT): The goal was to develop a new capability to intelligently randomize Ports, Waterways and Coastal Security (PWCS) activities in order to improve its asset utilization and, therefore, promote greater deterrence for this mission. This game-theory-based patrol scheduling tool was handed off to the RDC for initial accreditation and further development.

Dynamic Modeling for Arctic Resource Allocation (DMARA): The goal is to optimize Arctic resource allocation and assess how scarce resources can be allocated in interdependent, large-scale systems, given changing constraints, an evolving network, and missing data. This effort is in early conceptual research with users and down-range support has not yet been identified.

Port Resilience: The goal is to develop a decision framework for identifying critical information gaps and associated research questions, and making the right investments to mitigate these gaps. This collaborative initiative between a COE and Coast Guard was included as a project in our portfolio.



... Partnerships

COAST GUARD ACADEMY CADET CAPSTONE PROJECTS

The RDC sponsored Coast Guard Academy cadets and faculty to examine the feasibility of gray water ballasting on commercial and Coast Guard ships. A 2014 Civil Engineering capstone project involved two experiments and eight cadets. For one experiment, a bench-scale membrane bioreactor was designed and constructed to treat simulated cruise ship gray water. The membrane successfully removed over 95% of total suspended solids and turbidity. The other experiment looked at potential corrosion from gray water stored in ballast tanks. Future experiments are planned.

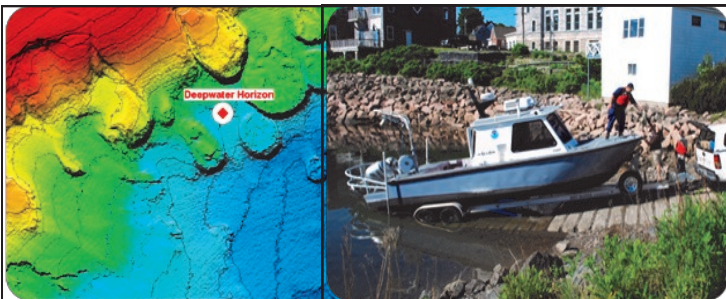


NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA)

Outside the Department, the RDC works closely as collaborators and performers with an alphabet soup of other agencies (e.g., Army Corps of Engineers (ACOE), BSEE,

CRREL, and NOAA) that have equity in maritime research, safety, and port operations.

The NOAA Office of Coast Survey Navigation Response Team 5 is now co-located at the RDC. The team includes one junior officer and two technicians. The arrangement will facilitate general connectivity and ongoing collaboration between the RDC and NOAA in areas that include Arctic Shield technology demonstrations and AIS transmit research. New collaborations may include the development of port-resilient decision support tools and the next generation of Arctic navigation technologies.



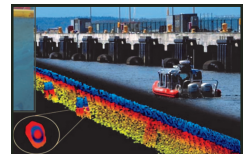
JOINT MARITIME TEST FACILITY (JMTF)



As an organizational element of the RDC, the JMTF in Mobile, AL maintains a permanent liaison between the RDC and the Naval Research Laboratory (NRL) in support of a Joint Research Agreement (JRA). JMTF provides RDC and NRL principle investigators with full-scale, in-situ mock-ups as the sole national testing facility for maritime fire protection research and other relevant maritime test environments for mission support equipment research.

JMTF Program Capabilities include:

- Port security systems
- Maritime Law Enforcement
- Homeland security tactics
- Maritime training platforms
- Surveillance and reconnaissance assets
- Environmental response equipment
- Full scale testing of fire protection systems
- 3D volumetric sonar
- Incidents Response training site
- In-Situ burn (ISB) meso-scale



Outreach Partnerships

We continue to increase our participation in Partnership in Education (PIE) programs with the local schools. Our ongoing partnership with the Interdistrict School for Arts and Communication (a local magnet school) includes a school-year-long program that teaches sixth graders the Scientific Method and aids them with water-related experimentation and presentation of their results. Another program involves three visits where we first give a lesson on simple machines, then provide a day of input/guidance to them in building their own simple machines. The final visit is for the teams to present their complex machines and show their calculations on mechanical advantage.

At another school we acted as judges/reviewers for the “Design a Colony to Sustain Life on Mars” projects. The RDC also had a visit by a marine science class from a local high school. These students were introduced to the Coast Guard and the role the RDC plays, followed by a tour of the facility.

This year we are sponsoring an award at the CT State Science Fair to provide a three week internship in the summer of 2015 for the winner of a special science fair category. The recipient will join our Arctic Science team for technology evaluations.

There will also be a high school student sponsored by NOAA and District 17. RDC staff will be the judges of the research projects in March 2015.



Although from the outside looking in we may at times appear to be a project portfolio execution machine, we are in fact much more and have positive influences inside and outside the organization.

“I liked just about everything of the Coast Guard project because I learned a lot and got to work with the Coast Guard.” – ISAAC student



“I liked the Coast Guard project because I learned a lot about density, measurement, and other measuring ways. It was also a lot of fun, and taught me about real-life Coast Guard situations.” – ISAAC student



“I liked the Coast Guard project because we learned about technology that they used to find harmful substances in the water.” – ISAAC student



Executive Director's Look Ahead

We had a very successful year with the delivery of many research products to our customers. These efforts have introduced and demonstrated new technologies and capabilities to Coast Guard operations, produced mission execution improvements, identified efficient alternatives to material and non-material systems/processes, and in some cases resulted in cost avoidance. We stood up the M&S Center-of-Expertise which is now supporting an increasing workload of new model development and fleet mix simulations for Coast Guard decision makers. We delivered what we promised to our customers.

Congress authorizes an RDT&E Appropriation for Coast Guard research that amounts to less than 0.2% of the Coast Guard's budget. As the sole R&D lab for the Coast Guard we intend to stretch every dollar and leverage and expand our partnering, so that we can execute as many projects for our stakeholders as we have in previous years. We will increase our use of CRADAs to build more public-private partnerships and reinforce our already productive partnerships within DHS S&T and other Agencies while seeking new collaborations wherever there are shared interests in maritime technology and Coast Guard missions. We will place emphasis on transition and include a transition readiness assessment on the back-end of every product we deliver. We will develop better processes to forage for technology and to more rapidly field prototypes to operators that are dealing with day-to-day practical realities of adaptive adversaries. The RDC has historically proven itself as being an agile asset by shifting its portfolio mix to where we are most needed and by providing subject matter experts in response to some of the biggest Coast Guard challenges. So, even in R&D, we have to be ready to support the next IONS when emergent technology and expertise is needed. We will ensure that the Coast Guard has the best possible workforce of scientists, engineers, and support personnel at the RDC. To do this we will recruit and attract high performing civilians and military by investing in our internship program and providing junior officers with challenging research, technology demonstrations, and operational field tests that improve mission performance with the added benefit of preparing them to be future leaders in innovation, strategic thinking, and champions of new technology.

I am excited about new project starts in 2015 that can have near-term applications like the abandoned object and vessel markers project, prototyping of a hoax location system, developing an automated method to provide SAR patterns to forward located assets, testing of tactile situational awareness system to reduce the potential for pilot spatial disorientation, and evaluating aviation laser eye protection for aviators in response to the increasing incidents of cockpit laser strikes. I am also pleased that we continue to work on projects that will lay the foundation for future new requirements and game-changing capabilities like taking a broader look at the use of unmanned systems across our mission spaces, demonstrating the benefits of eAtoN, and developing cyber security risk analysis methods for port infrastructure. Our efforts can all be tied back to any one of our 11 top-line missions and Coast Guard strategies. For example, our Arctic capability work in oil spill response and new efforts in asset optimization in counter-drug and migrant interdiction missions support the Coast Guard Arctic and Western Hemisphere Strategies. The RDC continues to be well-positioned as a strategic resource for the Coast Guard and DHS in 2015 and beyond.

Bert Macesker



A handwritten signature in blue ink, reading "Bert Macesker". The signature is fluid and cursive, with a long horizontal stroke at the end.

B.N. Macesker, XD, RDC



Mission

Provide innovative technologies, premier analysis, and decision support to enhance operational performance and reduce acquisition risk across all USCG missions.

Vision

To be the Coast Guard Authority for Research & Development; Test & Evaluation; and acquisition & operational analysis.



CGR&D Center

<http://www.uscg.mil/acquisition/rdc/rdc.asp>